



Status Forward Endcap EMC

PANDA Collaboration Meeting 19/2, GSI, Darmstadt, 2019

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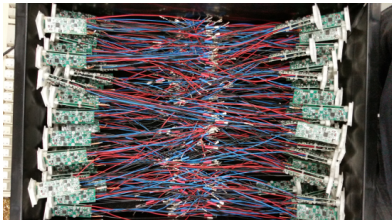
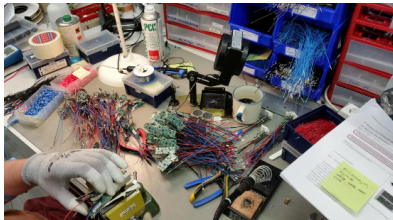
APD Submodule Production

- Submodule parts: Preparation and preassembly
- Stock of inventory at Bochum University:

Preamps delivered	2997/6176	All preamps available in Basel, tests ongoing
2-preamp units	415(+250)/3088	Bochum and Stockholm
LV cables red	4108/3088	3100/3088 assembled
LV cables blue	4459/3088	3100/3088 assembled
LV cables black	4140/3088	3100/3088 assembled
HV cables red	3180/3088	3103/3088 assembled
HV cables blue	4114/3088	3100/3088 assembled
HV cables black	3267/3088	3100/3088 assembled
Patch cables red	3100/3088	
Patch cables blue	3200/3088	
Patch cables black	6200/6176	
Signal cables	1860/6176	All available uncut at HISKP
Signal cable mark red	3671/3088	
Signal cable mark blue	5655/3088	
Aluminum inserts	769/772	need to search...
8-crystal mountplates	49/42	
16-crystal mountplates	190/172	
8-crystal alveoles	46/42	
16-crystal alveoles	165/172	Remaining ones at HISKP

APD Submodule Production

Cable bundle hoses (pink, yellow)	168/168 each	
Cable bundle hoses (red, blue, black, green)	688/688 each	
8-crystal ground strap pin	0/42	Raw material in stock
16-crystal ground strap pin	0/172	Raw material in stock
Capsules	3170/3088	
Cable bundle shrinking tube	3200/3088	
Aluminium shielding tape strips	3100/3088	Raw material in stock
Aluminum shielding tubes	3090/3088	
Cabled annealing LED Flex-PCBs	1142/3088	Equipped flex-cables and wires in stock
Carbon fibre crosses (type 1)	817/772	
Carbon fibre crosses (type 2)	813/772	
Crystal covers (3M DF2000MA)	3100/3088	
Crystals	3196/3088	
HV plugs	826/772	
LV plugs	828/772	
LED plugs	824/772	



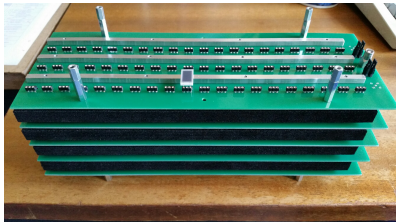
APD Submodule Production: APD Screening

- APD screening setup upgrade to twice the capacity finished mid of May
- Nominal throughput now 720 APDs per week (600 safe)

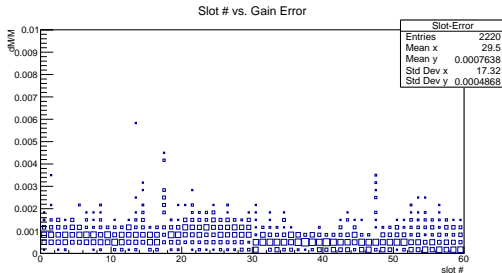
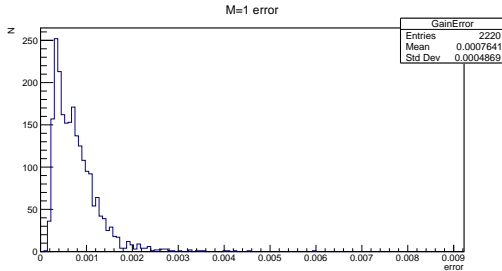
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	Möglich ab	Spätestens bis	03.06.2019	04.06.2019	05.06.2019	06.06.2019	07.06.2019	08.06.2019	09.06.2019
Morgens	04:00-08:00	9:00	Tom	Tom	Tom	Tom	Jan G.	Jan G.	Jan G.
Abends	18:00-19:00	22:00	Jan G.	Jan G.	Jan G.	Matthias	Matthias	Jan G.	Jan G.
KW 22			Montag	Dienstag	Mittwoch	Donnerstag	Freitag	Samstag	Sonntag
	Möglich ab	Spätestens bis	10.06.2019	11.06.2019	12.06.2019	13.06.2019	14.06.2019	15.06.2019	16.06.2019
Morgens	04:00-08:00	9:00	Jan G.		Tom		Tom	Jan	Matthias
Abends	18:00-19:00	22:00	Jan G.	Jan	Jan	Jan	Jan	Jan	Matthias
KW 23			Montag	Dienstag	Mittwoch	Donnerstag	Freitag	Samstag	Sonntag
	Möglich ab	Spätestens bis	17.06.2019	18.06.2019	19.06.2019	20.06.2019	21.06.2019	22.06.2019	23.06.2019
Morgens	04:00-08:00	9:00		Tom	Tom		Jan G.		Jan G.
Abends	18:00-19:00	22:00	Jan G.	Jan	Matthias	Malte	Malte	Jan G.	Jan
KW 24			Montag	Dienstag	Mittwoch	Donnerstag	Freitag	Samstag	Sonntag
	Möglich ab	Spätestens bis	24.06.2019	25.06.2019	26.06.2019	27.06.2019	28.06.2019	29.06.2019	30.06.2019
Morgens	04:00-08:00	9:00	Jan G.	Jan G.	Malte		Jan		
Abends	18:00-19:00	22:00	Malte	Malte		Malte			

APD Submodule Production: APD Screening

- Number of APDs fully (post irradiation) screened yet: 2550
- Plus number of new (non-irradiated) APDs screened yet: 480 (+4000 at JLU, prescreened at GSI) (+X at GSI)
- New PCBs (Giessen) for irradiation and transport/handling

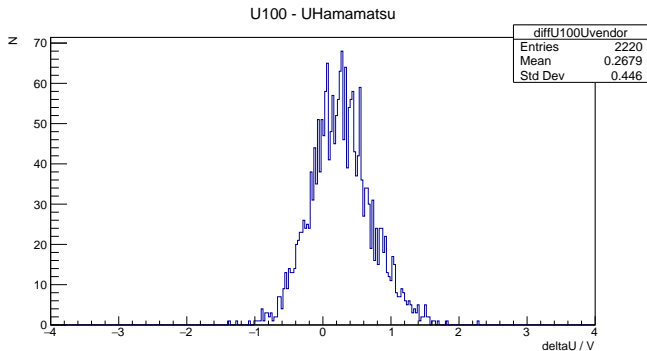


APD Screening: Gain 1 Determination



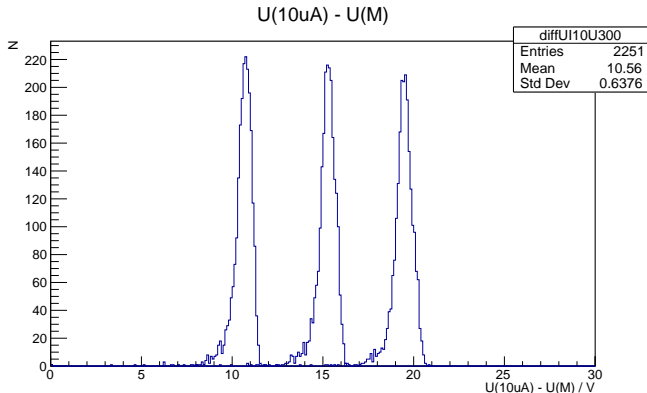
- APD gain determination depends on accurate gain 1 determination (@ 10-40 V)
- Sufficiently small errors only achievable with (recurring) selection of suitable ISEG HV modules

APD Screening: Gain 100



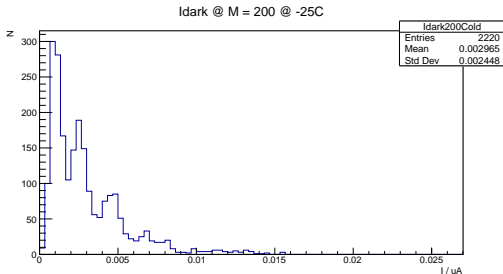
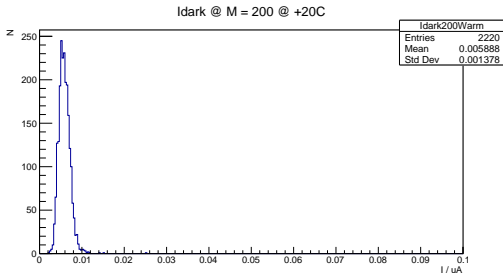
- Hamamatsu gives gain 100 related voltage only (@ about 20 degrees C)
- Difference may be dominated by lab temperature uncertainty at Hamamatsu factory

APD Screening: Breakdown Voltage Margins



- Voltage margins to "breakdown":
U(10 μ A)-U(M), M=300, 200, 150
- Universal 'barrel/endcaps (M=150/200) usage' possible

APD Screening: Dark Currents



- Annealed APDs:
 $I_{dark} < 40$ nA
(Hamamatsu specification for new APDs)
- At -25 degrees C dark currents correspondingly lower
- Uncertainty, however, 5...10 nA(?) (ISEG HV feature)

APD Submodule Production: APD Matching

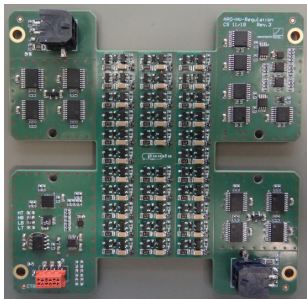
- First test matching by Matthias on 210 APDs:
- Goal: Best matching 16-APD groups
- Matching criterion: spread $\Delta U_{M=200}^2 + \Delta U_{M=300}^2$
- Start by looking at spread of each suitable APD pairs, retaining lowest spread combinations only
- Iteratively repeat this in order to build 4-, 8-, 16-APD groups
- 9 groups of 16-APDs out of 210 APDs, remaining ones back to larger pool matching...
- Worst group: mean deviation of 0.16 V, corresponding to 1.1 % gain change ($13.5/V \times 0.16 V$)
- Rolling matching: Start with stock of today and include/exclude APDs newly screened/already mounted

APD Submodule Production: APD Screening

- Start of APD submodule manufacturing within next two weeks
- Two submodules to be built, tested at HISKP, Bonn, then switch to mass production
- No reason yet for rejection of any APD measured so far (dark current, shape of gain curve after irradiation)
- Detailed APD screening/matching presentation by Jan Reher at 19/3 meeting

APD Submodule Production: HV Adjustment Board

- In addition to APD matching: HV adjustment (Bonn)
- 32 channel APD HV adjustment (1 submodule, 1 HV supply channel)
- Fully equipped PCBs exist and work
- Radiation hardness tests ongoing
- Detailed presentation by Christoph at 19/3 meeting

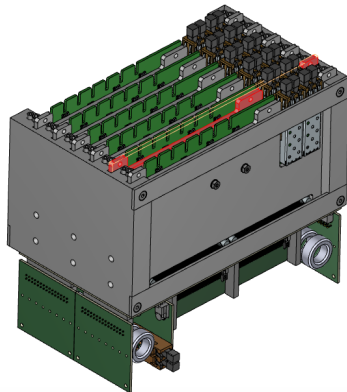
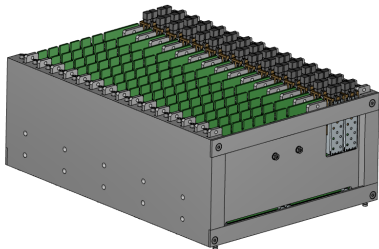


Forward Endcap Cooling/Mechanics

- New concept of filling cooling circuit by means of vacuum pump rather than bleeding valves on top of detector
- Cooling circuit (backplane cutout) mock-up from KVI:
 - ▶ Test of evacuation based filling
 - ▶ Test of flow control by calibrated drilled shims according to Claudius' coolant flow simulation

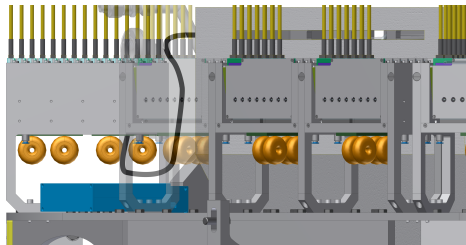
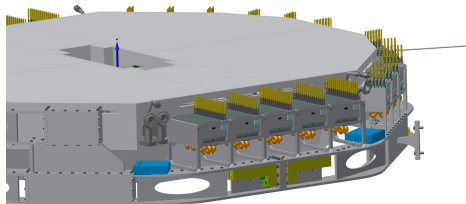
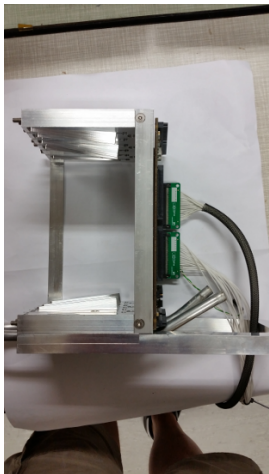


SADCs: Crates, Cabling



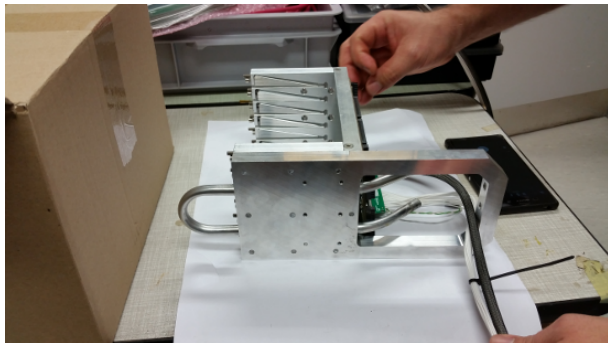
- Modified SADC crate design (KVI) as of March
- More modification necessary: Cooling flange extensions to power supply PCBs

SADCs: Crates, Cabling



- Space for cabling (by hand!) and routing (Signal and LV)!

SADCs: Crates, Cabling



- Cable-PCB guides/locks and/or strain reliefs for cable bundles need to be added
- Cabling tests at forward endcap w/ modified crate mock-up and real backplane foreseen for next week (Christoph) in order to check cable length estimations